

of where the vaccine needed to go next. It would also need to be asynchronous, for regions that have limited connectivity. And it had to be robust, resistant to tampering, and open.

"I just thought - they're trying to go geocaching!" Mohr remembers.

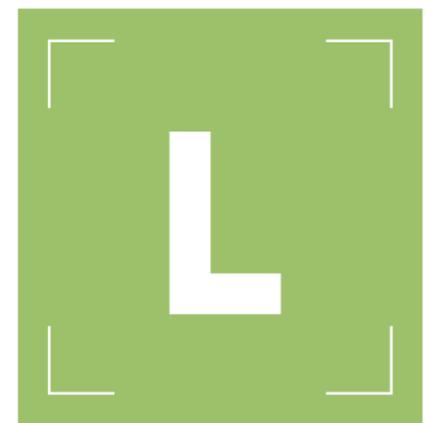
Mohr has recently been working with Groundspeak, the organisation that runs geocaching, and its API, to develop a proof-

of-concept application that will track vaccines. In 2014 she and GAVI Alliance will be piloting the system in various developing-world countries, piggybacking on Groundspeak's servers. If successful, vaccine-caching will be rolled out globally on a separate, parallel network. Thanks to millions of geeks, millions of children will be receiving their vaccines on time.

Tom Cheshire is WIRED's associate editor

Medical training gets gamified

Simulators will transform surgical instruction - while helping students to retain their competitive edge. *By Tom Cheshire*



osing a life in a videogame is no big deal - which is why they appeal to doctors. *Patient Rescue* by TruSim lets medical students understand their patients' discomfort better by feeling the pain they feel. The same company's *Triage Trainer* helps them prioritise complex emergency responses.

In 2014, surgeons will be doing much of their training in the virtual world, too, using programs developed by Mimic, a Seattle software firm; Sionix, an Israeli medical-training company; and Intuitive Surgical, makers of da Vinci, a multi-armed, scalpel-wielding robot controlled remotely by a surgeon through a console.

"We use virtual reality and computer-generated scenarios for surgeons to train," says Brian Miller, senior director of advanced product development at

Intuitive Surgical. "Prior to the simulator, surgeons would have to set up the entire da Vinci system in the operating room, put the instruments on and so on. This removes the need for that: flip one switch and start training." The Intuitive Surgical training system is a "backpack" that attaches to the same console used in actual operations. This provides the processing power for the surgeon to explore a computer-generated environment through the da Vinci's 3D viewer.

The system's main uses are currently for training motor- and cognitive-skills, according to Miller. Surgeons can improve their robo-aided aim by picking up virtual tacks, for instance. And the computer can also come up with challenging scenarios for doctors, creating virtual complications. Users get precise feedback: "We have a computer between the surgeons and instruments, so we can track all of the motions. You get time to complete, economy of motion and so on."

Other programs currently being developed give instant feedback: if a doctor applies too much pressure to a virtual patient, his instruments will glow red. Remote training also means that students can be taught by experts from different institutions geographically far apart.

Intuitive Surgical first prototyped the simulators in 2011 but next year marks a step change for the product. "We're getting more realistic environments - the photo

realism is more like a camera image as opposed to a 90s videogame." (Miller says the smoke effects from cauterising soft tissue are now particularly impressive.)

TINY PAYLOAD

Trackable capsules developed at Stockholm's Karolinska Institute will deliver drugs and help pinpoint cancers.

SPOT ILLUSTRATION: MATT HARRISON CLOUGH



And its software will also help qualified surgeons plan and prepare for an operation. A program developed by Sionix lets surgeons take pre-operative images of patients and merge them with virtual environments, so they can plan procedures.

Simulation will also guide R&D: the company will use the software to prototype designs for future medical instruments for the da Vinci system, "to determine whether there's a path for an actual product".

Miller plans to take the simulator to conferences and run competitions between surgeons. "They really get into the leaderboards," he says. Surgery is getting closer to videogames in more ways than one.

Tom Cheshire is WIRED's associate editor



MICROBUBBLE HEART IMAGING

Heart attacks will be easier to diagnose and treat using tiny gas-filled bubbles that travel through the bloodstream to the point of damage. Introduced intravenously, the microbubbles, developed at GE Global Research, reflect soundwaves, giving paramedics at the scene a very-high-resolution ultrasound image of the patient's heart. They could then be burst by changing the sound's acoustic setting to release anti-clotting agents at the point they are needed.



BIOSENSING TATTOOS

A simple temporary tattoo will tell athletes, soldiers and others involved in strenuous activity when they are about to hit the "wall" - the sudden energy drop caused by lactate levels in the blood becoming too high. Developed by a team at the University of California, San Diego, the electrochemical biosensor monitors lactate levels in the subject's sweat and alerts them when they approach the danger zone. Currently, lactate monitoring involves blood tests.

INSTANT HIV TREATMENT

Thanks to recent medical inroads, the prospect of an Aids-free world is no longer a theoretical one.

By Damien Brown

At last, some good news regarding HIV/Aids in Africa: more people than ever are being treated with safer, cheaper and increasingly effective

drugs, and we are now on the verge of bringing the spread of the virus down - using currently available treatments.

Today, more than seven million Africans living with HIV/Aids are receiving antiretroviral therapy (ART), an increase of almost 100-fold in less than a decade. Drug costs have decreased from \$10,000 (£6,320) per person annually to less than \$100 - the results of increased funding and a series of legal and trade decisions allowing poorer countries to access generic or discounted medications.

Newer treatments are also improved. Side effects are fewer, and triple-therapy combinations are increasingly provided as a single tablet, meaning improved adherence and lower potential for the emergence of drug resistance. Therapy is being started earlier and patients are living longer; rather than rescuing a broken immune system, we're preventing its deterioration. In line with this, the World Health Organisation recommended in July 2013 that ART be commenced when the CD4 (lymphocyte white cell) count drops below 500, rather than the previous cut-off of 350. Nine million more people are now eligible for ART in resource-limited countries, bringing the total to 26 million - about 75 per cent of the world's HIV carriers. Not all those eligible will immediately receive treatment, however: funding and health-system shortfalls mean millions won't, at least not for years; but there is consensus that this is what we should strive for.

But despite this rapid progress in treatment, we're losing the battle on a broader front: for every person who commences